ZERO BASE OPERATIONS COST STUDY
SRB PROJECT

ZERO BASE OPERATIONS COST STUDY
SRB

APPROACH

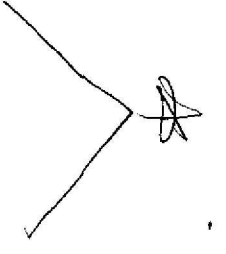
- USED POP 91-1 SUBMISSION AS THE BASIS FOR THIS STUDY
- EMPHASIS ON MANPOWER WITH ASSESSMENT AT SKILL LEVEL
- NO SECOND SHIFT OPERATIONS EXCEPT FOR SUPPORT TO SPC & REFURBISHMENT
- SUBCONTRACTS TO BE COMPLETED IN 1992 LEFT IN PLACE
- MAJOR SUBCONTRACTORS PROVIDED INPUT TO EFFECTS OF FLIGHT RATES
- INDIRECT RATES ASSESSED RELATIVE TO CHANGES IN BUSINESS BASE

ZERO BASE OPEr TIONS COST STUDY
MSFC – SOLID ROCKET BOOSTER
SHUTTLE OPERATIONS COSTS BY ELEMENT -- FY 94 IN RY $

PROJECT	ELEMENT	FLIGHT RATE ($)									
		1	2	3	4	5	6	7	8	9	10
SRB	PRODUCTION OPS	2.5	2.5	2.7	2.9	3.4	3.7	3.9	4.0	4.0	4.0
SRB	REFURBISHMENT OPS	1.2	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.8	1.8
SRB	PRODUCTION SUPPORT	3.4	3.4	4.1	4.3	4.7	4.9	5.2	5.2	5.2	5.2
SRB	ENGINEERING	10.1	10.1	10.8	12.5	14.2	15.5	16.5	17.4	17.4	17.4
SRB	QUALITY	3.1	3.1	3.4	3.4	3.5	3.6	4.4	5.6	5.7	5.7
SRB	MGMT/OTHER SUPPORT	7.6	7.6	8.5	8.9	9.3	9.6	10.1	10.6	10.6	10.6
SRB	SUB-CONTRACTS	21.1	22.9	24.2	25.4	27.8	29.3	34.0	36.5	44.8	52.1
SRB	OTHER DIRECT COSTS	6.2	6.9	8.5	8.7	9.7	10.6	12.5	12.4	13.9	13.9
SRB	BURDEN	22.9	22.9	24.9	28.0	30.8	32.4	34.8	36.6	36.7	36.7
SRB	G & A	15.3	15.5	16.2	16.8	17.0	17.2	17.3	17.5	17.5	18.4
SRB	FEE	12.0	12.3	13.4	14.4	15.6	16.4	18.0	18.9	20.2	21.2
SRB	PROJECT SUPPORT	5.6	5.6	5.7	5.9	5.9	5.9	6.0	6.1	6.2	6.2
	TOTAL	111.0	114.0	123.7	132.6	143.4	150.7	164.4	172.6	184.0	193.2

ZERO BASE OPERATIONS COST STUDY
SRB PROJECT
MAJOR DRIVERS TO THE MINIMUM BASE

FLIGHTS/YEAR	ELEMENT	RATIONALE
1	• ENGINEERING	• CRITICAL SKILLS FOR HUNTSVILLE & FLORIDA OPERATIONS
	• MANAGEMENT/OTHER	• CRITICAL SKILLS
	• PRODUCTION OPERATIONS	• CRITICAL SKILLS FOR TOUCH LABOR AND SUPPORT
	• SR&QA	• CRITICAL SKILLS FOR TOUCH LABOR AND SUPPORT
	• SUBCONTRACTS	• REPHASED BLOCK I PURCHASE WITH PENALTIES FOR: - INCREASE UNIT COST TO REFURBISH/REPAIR FLIGHT HARDWARE AT LOWER FLIGHT RATES - SHELF LIFE DICTATES PHASING PURCHASES ON LESS ECONOMICAL BASIS AT LOWER FLIGHT RATES



ZERO BASE OPERA..ONS COST STUDY
DETAILED BASE AND INCREMENT BRIEFING - SRB PROJECT
MAJOR DRIVERS TO FLIGHT RATE BASE AND INCREMENTS

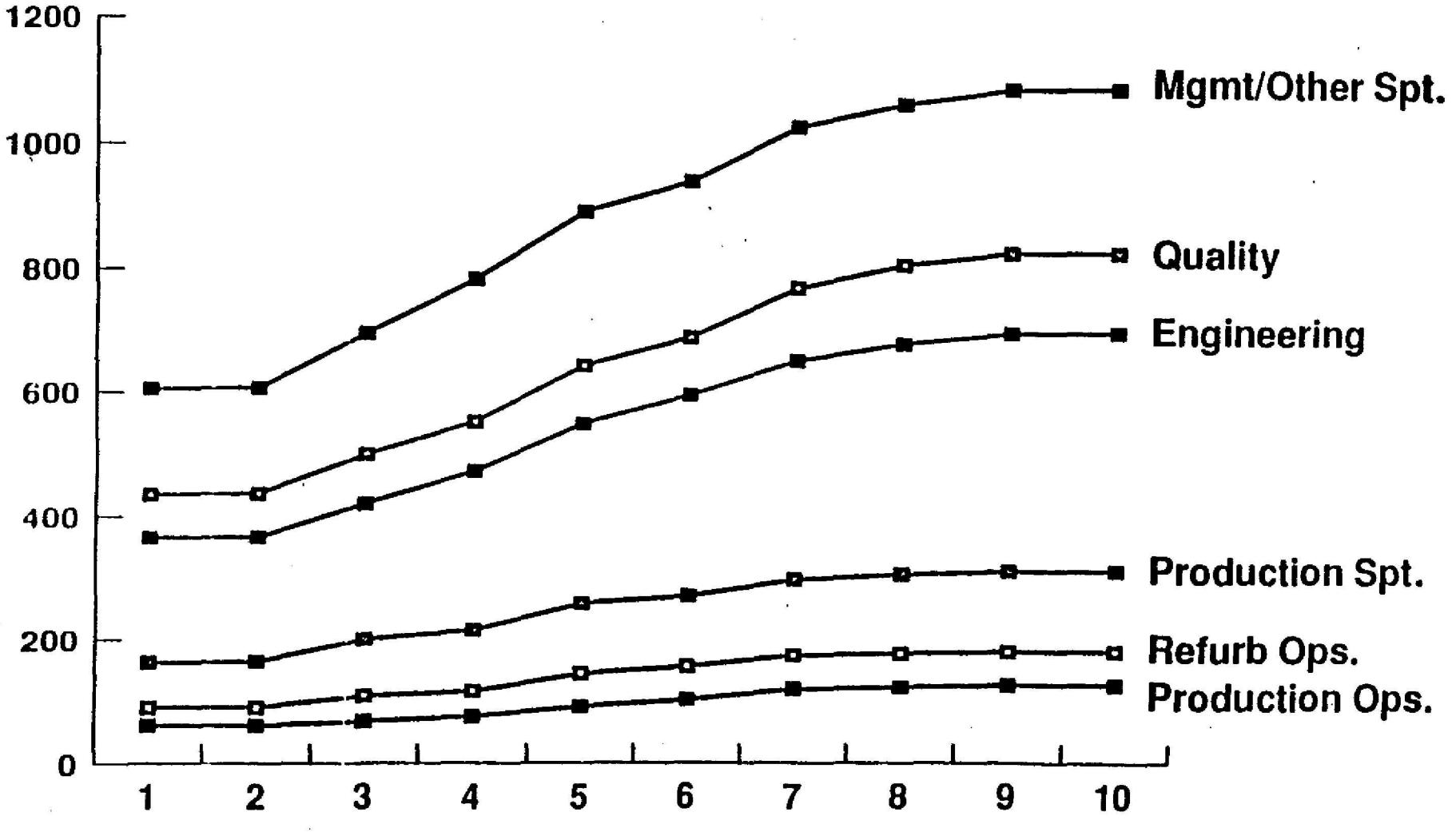
FLIGHTS/YEAR	RATIONALE
1 & 2 (BASE)	ALL MANPOWER ELEMENTS - PROJECT REQUIRES A MINIMUM SKILL LEVEL FOR THE CORE STAFF
3	PRODUCTION OPERATIONS - INCREASED HANDS ON LABOR, INSPECTION AND LOGISTICS
	SUBCONTRACTS - REPHASED BLOCK I PURCHASES
4	ENGINEERING - SEE NOTE BELOW
	SUBCONTRACTS - REPHASED BLOCK I PURCHASES
5	PRODUCTION OPERATIONS - IMPLEMENTED SELECTED SECOND SHIFT OPERATIONS IN REFURBISHMENT DUE TO INCREASED WORKLOAD
	ENGINEERING - SEE NOTE BELOW
	SUBCONTRACTS - REPHASED BLOCK I PURCHASES - BLOCK II BUY BEGINS FY97
6	ENGINEERING - SEE NOTE BELOW
	SUBCONTRACTS - REPHASED BLOCK I PURCHASES - BLOCK II BUY BEGINS FY95
7	ENGINEERING - SEE NOTE BELOW
	SUBCONTRACTS - REPHASED BLOCK I PURCHASES - BLOCK II BUY BEGINS FY94
8-10	PRODUCTION OPERATIONS - IMPLEMENTED SELECTED SECOND SHIFT OPERATIONS IN ASSEMBLY DUE TO INCREASED WORKLOAD
	ENGINEERING - SEE NOTE BELOW
	SUBCONTRACTS - REPHASED BLOCK I PURCHASES - BLOCK II BUY BEGINS FY94 AT 8/YR AND FY93 AT 9&10/YR

NOTE: HUNTSVILLE ENGINEERING
- 1-2 FLIGHTS: RESOURCE LOADING IS DETERMINED BY "CORE" STAFF REQUIREMENTS
- 3 FLIGHTS: "METRICS" ADD 27 EP'S OF WORK; 50% OR WORK CAN BE ABSORBED BY "CORE" STAFF. RESOURCES ARE INCREASED BY 14 EP'S.
- 3-8 FLIGHTS: RESOURCE LOADING FOR EACH FLIGHT REPRESENTS THE ADDITION OF THE 27 EP'S DETERMINED BY THE METRICS ANALYSIS. MINOR VARIATIONS OCCUR FROM FLIGHT TO FLIGHT DUE TO MINIMUM SKILLS REQUIREMENTS.

ZERO BASE OPERAT)NS COST STUDY

SRB PROJECT

MANPOWER SUMMARY BY FUNCTION (FY94) (MYE'S)

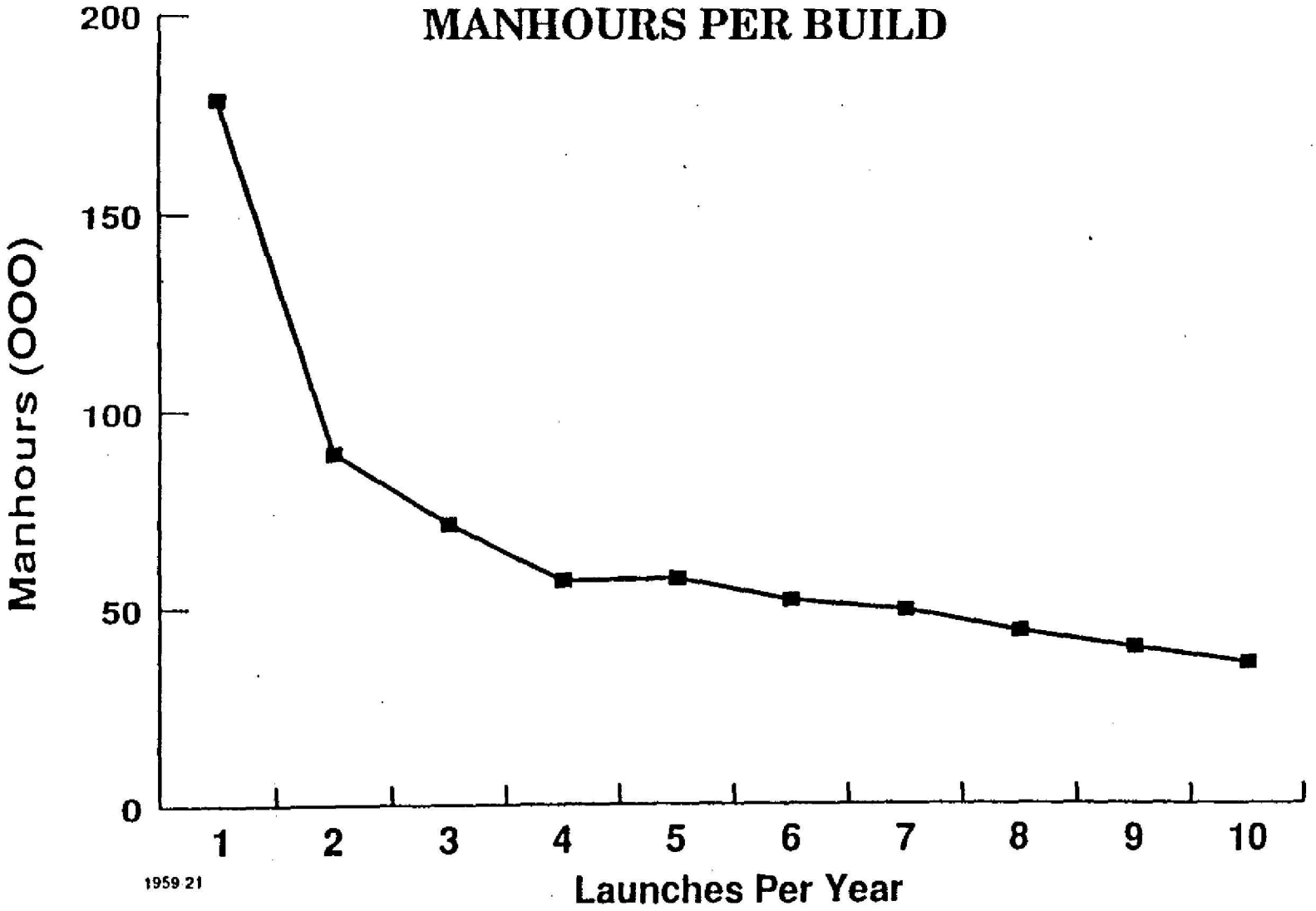


1959-102-17

ZERO BASE OPERAT ONS COST STUDY

SRB PROJECT

PRODUCTION OPERATIONS FY94 TOUCH LABOR - ASSEMBLY & REFURBISHMENT MANHOURS PER BUILD



1959-105-47

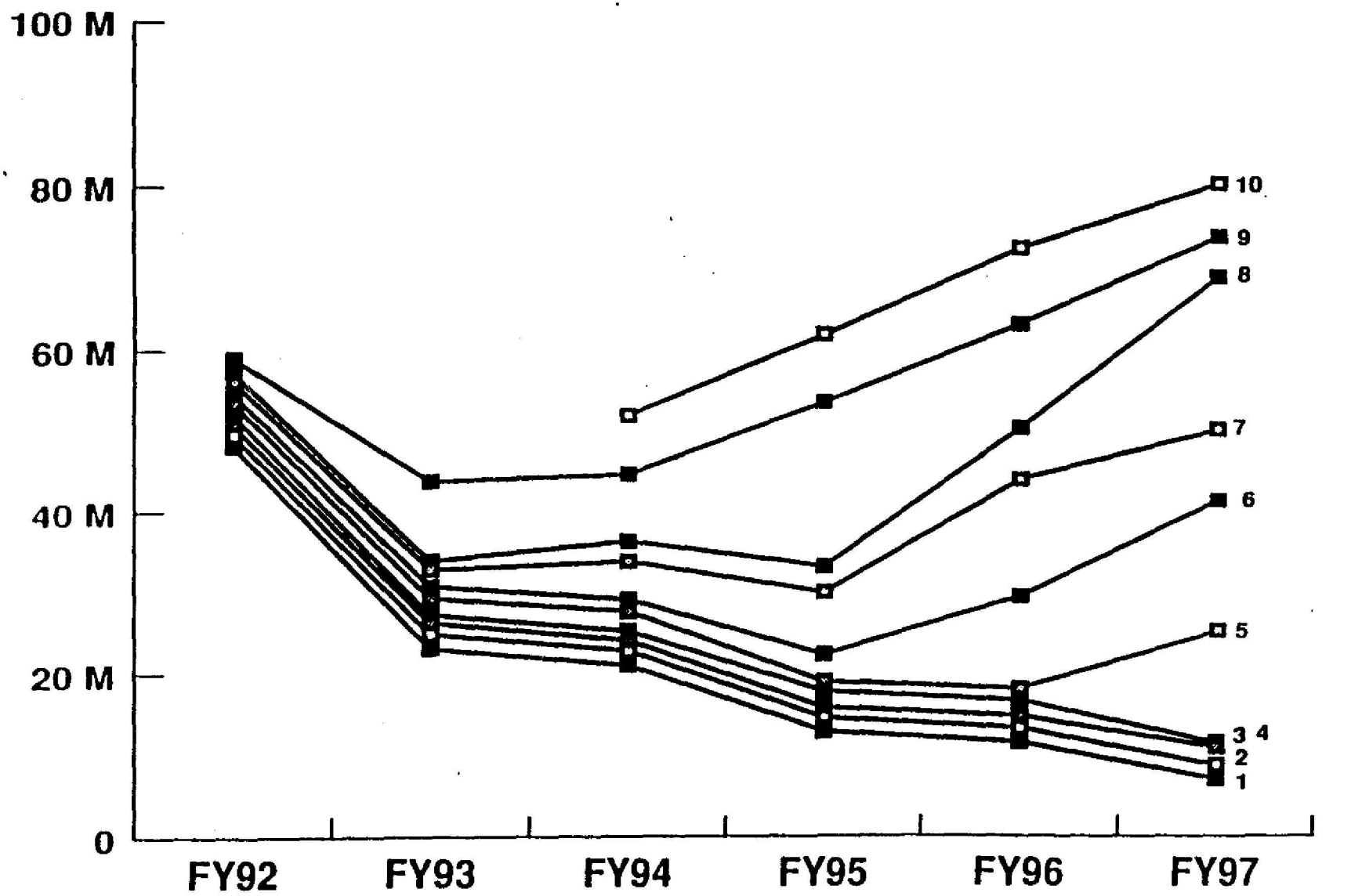
ZERO BASE OPERATIONS COST STUDY
SRB PROJECT
SUBCONTRACT GROUND RULES

- EXISTING PURCHASE ORDERS FOR BLOCK I HARDWARE PROCUREMENTS WERE NOT ADJUSTED, BUT WERE REPHASED FOR LOWER FLIGHT RATES
- SHELF LIFE SENSITIVE HARDWARE (PYROTECHNICS & BATTERIES) WILL REQUIRE ADDITIONAL TESTS/ PROCUREMENTS FOR BLOCK I
- VENDOR FLIGHT HARDWARE REFURBISHMENT COSTS WERE ADJUSTED TO LAUNCH RATES
  - MAJOR VENDORS FOR FLIGHT HARDWARE REFURBISHMENT WERE CONTACTED
- VENDOR SUSTAINING ENGINEERING COSTS WERE ADJUSTED TO LAUNCH RATES
- IDLM COSTS WERE ADJUSTED TO LAUNCH RATES
- PHASE IN FOR BLOCK II REQUIREMENTS WERE ADJUSTED BASED ON LAUNCH RATES

ZERO BASE OPERAT ONS COST STUDY

SRB PROJECT

SUB-CONTRACTS COST VS FLIGHT RATE (IN MILLIONS)



ZERO BASE OPERATIONS COST STUDY

SRB PROJECT

SUB-CONTRACTS COST SUMMARY (IN MILLIONS)

Maximum Flight Rate Per Year	*Program Funded Cost (RY $)*					
	FY92	FY93	FY94	FY95	FY96	FY97
1 Block I	48.1	23.2	21.1	12.9	11.6	7.1
2 Block I	49.5	25.0	22.9	14.6	13.3	8.8
3 Block I	50.7	26.4	24.2	15.9	14.8	11.0
4 Block I	51.9	27.4	25.4	17.9	16.7	11.6
5 Block I/Block II	53.4	29.4	27.8	19.1	18.2	14.8/10.6
6 Block I/Block II	54.6	30.9	29.3	20.5/2.0	19.5/10.2	16.8/24.8
7 Block I/Block II	56.1	33.0	31.5/2.5	22.0/8.2	19.4/24.8	18.1/32.3
8 Block I/Block II	57.3	34.1	32.5/4.0	23.1/10.3	21.6/29.0	9.0/60.3
9 Block I/Block II	59.0	37.6/6.3	33.5/11.3	23.8/30.0	12.0/51.5	3.9/70.4
10 Block I/Block II			36.2/15.9	23.9/38.3	11.2/61.7	0/80.8
POP 91-1 Flight Rate	9	9	10	10	10	10

1959-104-48

ZERO BASE OPERATIONS COST STUDY-C

KSC LAUNCH AND LANDING

WBS DESCRIPTIONS

SHUTTLE PROCESSING CONTRACT (SPC)

- **SHUTTLE PROCESSING (WBS 1.1)** -- Work associated with on-line operations required to process the Orbiter, Payload, External Tank (ET), Solid Rocket Boosters (SRB), and mission equipment through pre-launch, launch, post-launch, landing, and SRB retrieval activities.
  - ▸ Orbiter Operations (WBS 1.1.1) -- All tasks performed on the stand-alone Orbiter including routine maintenance, non-routine work associated with Problem Reporting and Corrective Action (PRACA), modifications, tile maintenance and modifications, and landing operations at primary/contingency landing sites.
  - ▸ Solid Rocket Booster (SRB) Operations (WBS 1.1.2) -- All tasks performed on the stand-alone SRB, including processing and modifications, stacking operations, preparation for mate to the ET, and retrieval and disassembly operations.
  - ▸ External Tank (ET) Operations (WBS 1.1.3) -- All tasks performed on the stand-alone ET, including receiving, processing the ET through the VAB ET checkout cell, modifications, and preparation for SRB/ET mate.
  - ▸ Launch Operations (WBS 1.1.4) -- All tasks required to mate the flight elements and process the integrated vehicle, including pre-launch servicing, integrated testing, and launch countdown.

ZERO BASE OPERATIONS COST STUDY-C

KSC LAUNCH AND LANDING

SHUTTLE OPERATIONS MANPOWER BY ELEMENT

ELEMENT	1	2	3	4	5	6	7	8	9	10
1.1 SHUTTLE PROC	1,262	1,364	1,461	2,187	2,348	2,495	2,856	3,141	3,208	3,333
1.2 SYSTEMS ENG/SPT	59	59	59	85	85	85	118	118	151	151
1.3 FACILITY O & M	769	769	769	1,044	1,089	1,089	1,468	1,468	1,483	1,483
1.4 LPS/INSTRU & CAL	408	408	408	588	588	588	768	768	768	768
1.5 OPS MODS	66	66	66	81	81	81	96	96	96	96
1.6 TECHNICAL OPS SPT	442	508	585	672	773	889	1,022	1,175	1,188	1,188
1.7 PROGRAM OPS SPT	211	252	293	334	375	415	423	430	433	433
1.9 COMMUNICATIONS	188	188	188	275	275	275	326	326	326	326
1.14.2 SPECIAL PROJ	3	3	3	3	3	3	3	3	3	3
BOC	190	195	205	221	229	236	242	247	247	247
LSS	18	19	20	21	22	22	22	22	22	22
PROP	0	0	0	0	0	0	0	0	0	0
94 TOTAL	3,616	3,831	4,057	5,511	5,868	6,178	7,344	7,795	7,926	8,051

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National Aeronautics and Space Administration
John F. Kennedy Space Center

KSC FORM 4-607 (REV. 1/88)

ZERO BASE OPERATIONS COST STUDY-C

KSC LAUNCH AND LANDING

SPC MANPOWER
WBS 1.1 -- SHUTTLE PROCESSING

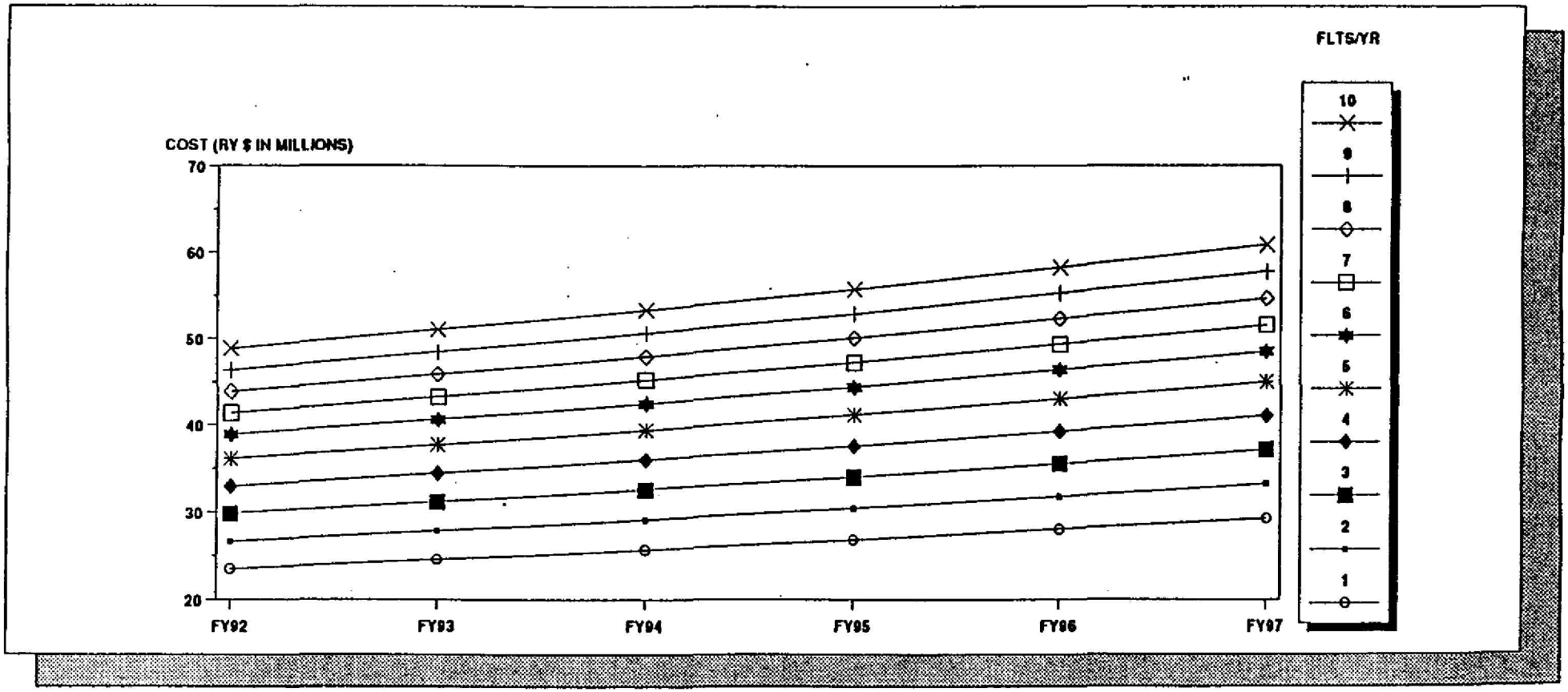
MAXIMUM FLIGHT RATE PER YEAR	FY92	FY93	FY94	FY95	FY96	FY97
1	1,262	1,262	1,262	1,262	1,262	1,262
2	1,364	1,364	1,364	1,364	1,364	1,364
3	1,461	1,461	1,461	1,461	1,461	1,461
4	2,187	2,187	2,187	2,187	2,187	2,187
5	2,348	2,348	2,348	2,348	2,348	2,348
6	2,495	2,495	2,495	2,495	2,495	2,495
7	2,856	2,856	2,856	2,856	2,856	2,856
8	3,141	3,141	3,141	3,141	3,141	3,141
9	3,208	3,208	3,208	3,208	3,208	3,208
10	3,333	3,333	3,333	3,333	3,333	3,333
POP 91-1 FLIGHT RATE	9	9	10	10	10	10

NASA
National Aeronautics and Space Administration
John F. Kennedy Space Center

ZERO BASE OPER. ?IONS COST STUDY-C

KSC LAUNCH AND LANDING

LSS COST VS. FLIGHT RATE



NASA
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KSC FORM 4 607 (REV. 1/88)

ZERO BASE OPERATIONS COST STUDY-C

KSC LAUNCH AND LANDING

WBS DESCRIPTIONS

PROPELLANTS

- **PROPELLANTS (WBS 2.0)** -- This effort includes the procurement of all propellants and gases purchased from other government agencies. Propellants include: liquid hydrogen, gaseous helium, gaseous nitrogen, liquid oxygen, hydrazines, and nitrogen tetroxide. Also included is the allocation for the management of the LH2 plant in New Orleans.

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ZERO BASE OPERATIONS COST STUDY-C

KSC LAUNCH AND LANDING

PROPELLENT COST VS FLIGHT RATE

MAXIMUM FLIGHT RATE PER YEAR	FY92	FY93	FY94	FY95	FY96	FY97
1	7.0	7.3	7.7	8.0	8.4	8.7
2	7.5	7.8	8.1	8.5	8.9	9.3
3	8.5	8.9	9.3	9.7	10.2	10.6
4	9.6	10.0	10.5	11.0	11.5	12.0
5	10.7	11.2	11.7	12.2	12.7	13.3
6	11.8	12.3	12.9	13.4	14.0	14.7
7	14.9	15.5	16.2	16.9	17.7	18.5
8	15.9	16.6	17.4	18.2	19.0	19.9
9	17.0	17.8	18.6	19.4	20.3	21.2
10	18.1	18.9	19.8	20.6	21.6	22.5
POP 91-1 FLIGHT RATE	9	9	10	10	10	10

NASA
John F. Kennedy Space Center

ZERO BASE OPERATIONS COST STUDY
VARIABLE COST VERSES MARGINAL COST
FOR A FY94 FLIGHT

FLIGHT/YEAR	TOTAL COST	VARIABLE COST	MARGINAL COST ADD A FLIGHT	MARGINAL COST DELETE A FLIGHT
1	2024.1			
		52.9	65.1	-37.7
2	2077.0			
		87.0	63.3	-39.1
3	2164.0			
		209.1	191.6 *	-41.4
4	2373.1			
		143.5	95.6	-56.6
5	2516.6			
		132.9	90.5	-56.9
6	2649.5			
		224.2	181.4 *	-57.1
7	2873.7			
		140.7	106.3	-57.3
8	3014.4			
		104.4	75.4	-57.5
9	3118.8			
		86.5	71.2	-57.8
10	3205.3			

AVG = 131.2

* - DRIVEN BY KSC LAUNCH AND LANDING

NOTE: ASSUMES 4 ET'S PER YEAR MINIMUM BUILD
AND 3 FLIGHTS PER YEAR MINIMUM SSME SUPPORT

ZERO BASE OPERATIONS COST STUDY

ADDITION OR DELETION OF 1 LAUNCH FROM STEADY STATE RATE

- <u>ASSUMPTIONS</u>
  - AT LEAST 2 YEAR NOTIFICATION
  - AVERAGE COMPLEXITY MISSION
  - USED FY94 AS REPRESENTATIVE YEAR FOR ± 1 FLIGHT

MARGINAL COST PER FLIGHT
1 FLT OUT OF FY94 – RY$

PROJECT	SINGLE FLT MARGINAL COST*	MARGINAL COST CONTENT
MSFC		
SSME	1.8	REFURB TOUCH LABOR, PRODUCT INSPECTION, HARDWARE MATERIAL
SRB	10.3	PROD TOUCH LABOR, INSPECTION, VENDOR REPAIRS, EXPENDABLE & ATTRITION HARDWARE
RSRM	14.6	TOUCH LABOR AND EXPENDABLE MATERIAL
ET	15.0	TOUCH LABOR, INSPECTION, FLIGHT HARDWARE
JSC		
MOD	1.2	STSOC MISSION PLANNING, FLT READINESS ASSESSMENT, FLT EXECUTION, POST FLT ACTIVITIES
ENG	0.5	CREW TRAINING AND FAMILIARIZATION, DIRECT MISSION SUPPORT ACTIVITIES, FLT HARDWARE TEST & CERT, SYSTEMS PERFORMANCE VERIFICATION
ORBITER	1.8	
	0.3	OPS SUPPORT & LAUNCH SITE SUPPORT
	0.3	FEPC CONSUMABLES
	0.9	ET DISCONNECTS
	0.3	RMS OVERHAUL & REPAIR
FCOD	0.5	FLT OPS OF ORBITER FERRY, KC-135 PATHFINDER, STA TRAINING; ASSUMES LANDING AT DFRC

* THESE REDUCTIONS ARE APPLICABLE AT ALL FLIGHT RATES EXCEPT FOR SRB AND RSRM

MARGINAL COST PER FLIGHT
1 FLT OUT OF FY94 – RY.

PROJECT	SINGLE FLT MARGINAL COST*	MARGINAL COST CONTENT
KSC		
LOGISTICS OPERATIONS	3.7	REPLENISHMENT SPARES & OVERHAUL AND REPAIRS
PROPELLANTS	1.1	ONBOARD PROPELLANTS
SPC	0.7	FREIGHT & TRAVEL FOR ALTERNATE LANDING SITES
BOC	0.1	PROPELLANT HANDLING M/P ABOVE CORE
LSS	2.7	RANGE SUPPORT, CLS XENON LIGHTS, SLS SUPPORT AT EAFB, PHOTO SUPPORT
P/L OPERATIONS	0.2	TRANSPORTATION TO THE PAD; ASSUMES P/L OF OPPORTUNITY OR DOD P/L IS DELETED
SSP		
INTEG & OPS	1.1	CARGO INTERFACE DOCUMENTATION, ENGINEERING ASSURANCE AND CARGO INTEG MGMT
OPS INTEG	0.2	DDMS INCLUDING RANGE SPT FOR EACH LAUNCH ATTEMPT
ENGINEERING INTEG	2.3	MISSION CONFIG REQMTS, MASS PROP/TRAJ DESIGN DATA PACK, ASCENT FLT DESIGN, FLT MARGINS ASSESS, LSEAT & MISSIONS SPT, POST FLT ANALYSIS, FLT S/W INTEG, OMRS/LCC
TOTAL $M	57.8	

* THESE REDUCTIONS ARE APPLICABLE AT ALL FLIGHT RATES EXCEPT FOR SRB AND RSRM

SRB PROJECT
ZERO BASE OPERATIONS COST STUDY

($ IN MILLIONS)

FY94 FLIGHT DELETED (SAVINGS)						
BASE RATE	FY94	FY95	FY96	FY97	FY98 +	TOTAL
1/YR					7.0	7.0
2					7.0	7.0
3	0.6	0.9			7.0	8.4
4	0.6	1.0		0.3	7.0	8.9
5	0.7	1.1		1.1	6.2	9.1
6	0.8	1.3	0.3	1.8	5.1	9.4
7	0.9	1.4	0.6	2.1	4.7	9.6
8	1.0	1.5	0.6	2.5	4.2	9.8
9	1.1	1.9	0.6	2.9	3.5	10.0
10	1.3	1.7	0.6	3.4	3.3	10.3

RSRM . .\OJECT
ZERO BASE OPERATIONS COST STUDY

($ IN MILLIONS)

FY94 FLIGHT DELETED (BUDGET DECREASE)			
BASE RATE	FY93	FY94	TOTAL
1/YR			
2		-9.8	-9.8
3		-9.8	-9.8
4		-9.8	-9.8
5		-9.8	-9.8
6		-9.8	-9.8
7	-3.5	-11.1	-14.6
8	-3.5	-11.1	-14.6
9	-3.5	-11.1	-14.6
10	-3.5	-11.1	-14.6

MARGINAL COST / FLIGHT
1 FLIGHT ADDED IN FY94 – RY$
(FROM 9 TO 10)

PROJECT	SINGLE FLT MARGINAL COST	MARGINAL COST CONTENT
MSFC		
SSME	5.2	REFURB TOUCH LABOR, PRODUCT INSPECTION, HARDWARE MATERIAL
SRB	9.8	PROD TOUCH LABOR, INSPECTION, VENDOR REPAIRS, EXPENDABLE & ATTRITION HARDWARE
RSRM	14.6	TOUCH LABOR AND EXPENDABLE MATERIAL
ET	14.0	TOUCH LABOR, INSPECTION, FLIGHT HARDWARE
JSC		
MOD	1.2	STSOC MISSION PLANNING, FLT READINESS ASSESSMENT, FLT EXECUTION, POST FLT ACTIVITIES
ENG	0.5	CREW TRAINING AND FAMILIARIZATION, DIRECT MISSION SUPPORT ACTIVITIES, FLT HARDWARE TEST & CERT, SYSTEMS PERFORMANCE VERIFICATION
ORBITER	1.8	
	0.3	OPS SUPPORT & LAUNCH SITE SUPPORT
	0.3	FEPC CONSUMABLES
	0.9	ET DISCONNECTS
	0.3	RMS OVERHAUL & REPAIR
FCOD	0.5	FLT OPS OF ORBITER FERRY, KC-135 PATHFINDER, STA TRAINING: ASSUMES LANDING AT DFRC

MARGINAL COST F FLIGHT
1 FLIGHT ADDED IN FY94 – RY$
(FROM 9 TO 10)

PROJECT	SINGLE FLT MARGINAL COST	MARGINAL COST CONTENT
KSC		
LOGISTICS OPERATIONS	3.7	REPLENISHMENT SPARES & OVERHAUL AND REPAIRS
LAUNCH & LANDING	16.1	
PROPELLANTS		ONBOARD PROPELLANTS
SPC		FREIGHT & TRAVEL FOR ALTERNATE LANDING SITES
BOC		PROPELLANT HANDLING M/P ABOVE CORE
LSS		RANGE SUPPORT, CLS XENON LIGHTS, SLS SUPPORT AT EAF PHOTO SUPPORT
P/L OPERATIONS	0.2	TRANSPORTATION TO THE PAD: ASSUMES P/L OF OPPORTUNITY OR DOD P/L IS DELETED
SSPO		
INTEG & OPS	1.1	CARGO INTERFACE DOCUMENTATION, ENGINEERING ASSURANCE AND CARGO INTEG MGMT
OPS INTEG	0.2	DDMS INCLUDING RANGE SPT FOR EACH LAUNCH ATTEMPT
ENGINEERING INTEG	2.3	MISSION CONFIG REQMTS, MASS PROP/TRAJ DESIGN DATA PACK, ASCENT FLT DESIGN, FLT MARGINS ASSESS, LSEAT & MISSIONS SPT, POST FLT ANAYSIS, FLT S/W INTEG, OMRS/LCC
TOTAL $M	71.2	

S..ME

ZERO BASE OPERATIONS COST STUDY

ADDITION OF ONE FLIGHT IN FY94

FLIGHT RATE	FY94	FY95	FY96	FY97	TOTAL
3	.8	2.7	4.4	7.9	15.8
4	.3	.9	1.4	2.6	5.2
5	.3	.9	1.5	2.6	5.3
6	.4	1.4	2.3	4.1	8.2
7	.3	.9	1.4	2.6	5.2
8	.4	1.2	1.9	3.5	7.0
9	.3	.9	1.4	2.6	5.2
10					

SRB PROJECT
ZERO BASE OPERATIONS COST STUDY

($ IN MILLIONS)

FY94 FLIGHT ADDED (BUDGET INCREASE)							
BASE RATE	FY93	FY94	FY95	FY96	FY97	FY98 +	TOTAL
1/YR						7.0	7.0
2	0.6	0.3	1.0			7.0	8.9
3	0.6	0.6	1.0			7.0	9.1
4	0.5	0.7	1.1			7.0	9.2
5	0.5	0.7	1.3		1.1	5.8	9.4
6	0.3	0.8	1.4	0.3	1.8	4.8	9.5
7	0.3	0.8	1.5	0.6	2.1	4.3	9.6
8	0.2	0.9	1.6	0.6	2.5	4.0	9.8
9	0.2	0.7	1.7	0.6	2.9	3.8	9.8
10	0.1	1.0	1.7	0.6	3.4	3.4	10.3

RSRM PROJECT
ZERO BASE OPERATIONS COST STUDY

($ IN MILLIONS)

FY94 FLIGHT ADDED (BUDGET INCREASE)			
BASE RATE	FY93	FY94	TOTAL
1/YR			
2		9.8	9.8
3		9.8	9.8
4		9.8	9.8
5		9.8	9.8
6		9.8	9.8
7	3.5	11.1	14.6
8	3.5	11.1	14.6
9	3.5	11.1	14.6
10	3.5	11.1	14.6

EXTERNAL TANK
ZERO BASE COST STUDY

COSTS (FY91 $M)

PRODUCTION RATE:	4/YR	5/YR	6/YR	7/YR	8/YR	9/YR	10/YR
	$350M	$364M	$379M	$396M	$413M	$428M	$442M
BETWEEN PROD. RATES:		$14M	$15M	$17M	$17M	$15M	$14M

COST DISTRIBUTION

- EACH PRODUCTION RATE HAS A UNIQUE COST DISTRIBUTION. "LOOK-BACK" COSTS ARE EFFECTED BY FLIGHT HARDWARE PROCUREMENT, SHIFTING ASSUMPTIONS, AND FLOW TIME.

ZERO BASE OPERATIONS COST STUDY

KSC LAUNCH AND LANDING

- COST FOR ADDITIONAL MISSION
  - COST AT NEXT HIGHER INCREMENTAL LAUNCH RATE FOR 1 1/4 YEARS
  - 12 MONTHS OF "OPERATION" AT NEXT HIGHER LEVEL
  - 3 MONTHS PENALTY COST (INCLUDES HIRING, TRAINING, CERTIFICATION OF PERSONNEL, TERMINATION OF PERSONNEL, ABILITY TO ADD MISSION)
  - CONTINGENT UPON AVAILABILITY OF ORBITERS, FACILITIES & GSE, IMPLEMENTATION OF NEW SHIFTING REQUIREMENTS, ETC.

BASE RATE	FY94
1/YR	32.0
2	28.3
3	140.6
4	41.4
5	34.7
6	120.6
7	48.4
8	17.5
9	16.1
10	

DEFINITION OF TERMS

- DEVELOPMENT (PRODUCTION)

  ALL ACTIVITIES INVOLVED IN ATTAINING AND IMPLEMENTING THE INITIAL CAPABILITY OF A SYSTEM PLUS THE EFFORTS ASSOCIATED WITH SUBSEQUENT ENHANCING/UPGRADING. THIS ACTIVITY SHOULD INCLUDE, BUT NOT BE LIMITED TO, THE DESIGN, FABRICATION, TEST, AND CERTIFICATION OF NEW OR MODIFIED HARDWARE, E.G., IMPROVED APU, CCTV, EDO, ETC. THIS ACTIVITY SHOULD INCLUDE MAJOR HARDWARE REDESIGN EFFORTS THAT HAVE BEEN INITIATED TO CORRECT FAILURES ON SYSTEMS THAT OCCURRED DURING ATP, GROUND TEST, FLIGHT OPERATIONS, ETC.

- OPERATIONS

  ALL ACTIVITIES INVOLVED IN THE DAY-TO-DAY REPETITIVE EFFORTS REQUIRED TO INSURE A SYSTEM CAN ROUTINELY PERFORM ITS FUNCTION/MISSION. SUSTAINING ENGINEERING IS CONSIDERED TO BE A SUBSET OF OPERATIONS, AND INCLUDES ALL ACTIVITIES ASSOCIATED WITH GROUND TURNAROUND, PRELAUNCH, FLIGHT, AND POST LANDING SUPPORT.

  - EXAMPLES OF SUSTAINING ENGINEERING ACTIVITIES:

    - GROUND TURNAROUND - WAIVERS, EXCEPTIONS, RCN EVALUATIONS, PROBLEM ANALYSIS, BUT NOT REDESIGN, ETC.

    - PRELAUNCH - COFR ACTIVITIES, I-LOADS VERIFICATION, LCC REVIEWS, ETC.

    - FLIGHT - MISSION SUPPORT, IFA ANALYSIS, FILE IX ASSESSMENT, MISSION REPORT, ETC.

SUSTAINING ENGINEERING IS BASICALLY A SYSTEM EVALUATION/ASSESSMENT ACTIVITY AND DOES NOT INCLUDE MAJOR DESIGN, FABRICATION OR TEST.

SPACE SHUTTLE POP 91-2 JDGET RECOMMEND CANDIDATES FOR PRODUCTION TRANSFERS TO OPERATIONS NOA RY M$

PROJECT	PURPOSE	FY92	FY93	FY94	FY95	FY96	FY97	RECOM'D XFER
CURRENT PROPOSED CHANGES								
RSRM	TOOLING	2.1	0.8	3.6	0.8	4.1	4.1	YES
RSRM	PROJECT SUPPORT	6.3	6.1	6.2	5.3	5.3	5.4	YES
SSME	TEST SUPPORT	TBD	TBD	TBD	TBD	TBD	TBD	NO
SSME	INST AND PROGRAM SUPPORT	6.8	7.1	7.3	7.6	7.9	8.3	YES
ENG INTG	PCASS	5.4	5.2	5.0	4.9	4.7	4.5	YES
ENG INTG	IMIC	4.6	4.8	5.0	5.1	5.3	5.5	YES
ENG INTG	SYSTEMS INTEG	1.4						YES
ENG INTG	AVIONICS SYSTEMS ENG	1.1	1.2	1.2	1.3	1.3	1.4	YES
OPS INTG	LANDING SUTE/SPARES	2.5	0.8	0.7	0.5	0.3	0.3	YES
OPS INTG	LAKEBED STATUS	0.2	0.2	0.2	0.2	0.2	0.2	YES
OPS INTG	MISSION SUPPORT	0.4	0.4	0.4	0.5	0.5	0.5	YES
MGMT INT	EQ & SERVICES (ADP, COMM & INFO MGMT SYSTEMS)	2.5	1.6	1.7	1.6	1.6	1.7	YES
ENG	FLIGHT DATA SYSTEMS (ORB DATA SYS SPT – RECONFIG DATA REV & VERIFICATION)	1.0	1.0	1.1	1.1	1.2	1.2	YES
ENG	NAV CONTROL AND AERONAUTICS (MISSION TO MISSION SPT: SUBSYSTEM MGMT., SAIL TEST, SES TEST, I-LOAD SELECTION AND DEFINITION)	6.5	6.8	7.1	7.5	7.8	8.1	YES
ENG	SYSTEMS ENGINEERING (SES SPT: ON-ORBIT TRAINING & PROCEDURE DEVELOPMENT)	2.7	2.9	3.0	3.1	3.3	3.4	YES
ENG	STRUCTURES & MECHANICS (ORBITER AERO EVALUATION)	0.1	0.1	0.1	0.1	0.1	0.1	YES
ENG	TRACKING & COMMUNICATIONS (SUBSYS MGMT SPT: ANALYSIS, GFE, MSBLS, CCTV)	1.7	1.8	1.9	2.0	2.0	2.1	YES
ENG	CREW & THERMAL SYSTEMS (ECLSS SUBSYSTEM MANAGEMENT SUPPORT)	0.3	0.3	0.4	0.4	0.4	0.4	YES
ENG	PROPULSION & POWER (SUBSYSTEM MGMT SPT: PREFLIGHT ACTIVITIES, REAL-TIME MISSION SUPPORT, DATA ANALYSES)	1.7	1.7	1.8	1.9	2.0	2.1	YES
ENG	PROPULSION & POWER (GFE PYROTECHNICS)	0.3	0.3	0.3	0.3	0.3	0.3	YES
MOD	MCC UPGRADE	5.0	5.2	5.5	5.7	6.0	6.2	YES
TOTAL		52.6	48.3	52.5	49.9	54.3	55.8	

SPACE SHUTTLE POP 91-2 BUDGET RECOMMEND CANDIDATES FOR OPERATIONS TRANSFERS TO PRODUCTION NOA RY M$

PROJECT	PURPOSE	FY92	FY93	FY94	FY95	FY96	FY97	RECOM'D XFER
CURRENT PROPOSED CHANGES								
ENG INTEG	DEVELOPMENT FOR FLIGHT OPS	6.3	2.3	2.7	2.8	3.0	3.1	NO
ET	TECHNICAL DIRECTIVES ALLOW	9.2	8.0	6.4	6.4	6.0	6.5	NO
ORBITER	STUDIES AND ANALYSIS (40 EP'S)	5.8	6.1	6.3	6.6	6.9	7.2	YES
ENG	NAVIGATION CONTROL AND AERONAUTICS (NEW SOFTWARE DEFINITION & DEVELOPMENT: GPS/DTO, BASIC ASCENT GUIDE, ASCENT ANALYSIS)	5.4	5.7	6.0	6.2	6.5	6.8	YES
ENG	TRACKING & COMMUNICATION (ELECTROMAGNETIC EFFECTS-NEW & IMPROVED H/W)	0.2	0.2	0.2	0.2	0.2	0.2	YES
ENG	PROPULSION & POWER (ORBITER ENHANCEMENT TESTING)	1.8	1.9	2.0	2.1	2.2	2.3	YES
ENG	PROPULSION & POWER (P/L TEST SPT: EVALUATION TEST OF IMPROVED COMPONENTS)	0.3	0.3	0.3	0.4	0.4	0.4	YES
ENG	AUTOMATION & ROBOTICS (FLIGHT CREW EQ DEVELOPMENT)	0.1	0.1	0.1	0.1	0.1	0.1	YES
SUBTOTAL		29.1	24.6	24.0	24.8	25.3	26.6	
PROPOSED IN 91-1 RECOMMEND								
SSME	ATD IMPLEMENTATION	14.6	68.9	87.6	77.9	72.5	67.3	
TOTAL		43.7	93.5	111.6	102.7	97.8	93.9	

SPACE SHUTTLE POP 91-2 BUDGET RECOMMEND CANDIDATES FOR OPERATIONS TRANSFERS TO PRODUCTION NOA RY M$

PROJECT	PURPOSE	FY92	FY93	FY94	FY95	FY96	FY97	RECOM'D XFER
CURRENT PROPOSED CHANGES								
ENG INTEG	DEVELOPMENT FOR FLIGHT OPS	6.3	2.3	2.7	2.8	3.0	3.1	NO
ET	TECHNICAL DIRECTIVES ALLOW	9.2	8.0	6.4	6.4	6.0	6.5	NO
ORBITER	STUDIES AND ANALYSIS (40 EP'S)	5.8	6.1	6.3	6.6	6.9	7.2	YES
ENG	NAVIGATION CONTROL AND AERONAUTICS (NEW SOFTWARE DEFINITION & DEVELOPMENT: GPS/DTO, BASIC ASCENT GUIDE, ASCENT ANALYSIS)	5.4	5.7	6.0	6.2	6.5	6.8	YES
ENG	TRACKING & COMMUNICATION (ELECTROMAGNETIC EFFECTS-NEW & IMPROVED H/W)	0.2	0.2	0.2	0.2	0.2	0.2	YES
ENG	PROPULSION & POWER (ORBITER ENHANCEMENT TESTING)	1.8	1.9	2.0	2.1	2.2	2.3	YES
ENG	PROPULSION & POWER (P/L TEST SPT: EVALUATION TEST OF IMPROVED COMPONENTS)	0.3	0.3	0.3	0.4	0.4	0.4	YES
ENG	AUTOMATION & ROBOTICS (FLIGHT CREW EQ DEVELOPMENT)	0.1	0.1	0.1	0.1	0.1	0.1	YES
SUBTOTAL		29.1	24.6	24.0	24.8	25.3	26.6	
PROPOSED IN 91-1 RECOMMEND								
SSME	ATD IMPLEMENTATION	14.6	68.9	87.6	77.9	72.5	67.3	
TOTAL		43.7	93.5	111.6	102.7	97.8	93.9	

EXTERNAL TANK
ZERO BASE OPERATIONS COST STUDY

ZERO BASE OPERATIONS COST STUDY
EXTERNAL TANK
GROUNDRULES AND ASSUMPTIONS

- INCREMENTS FOR ANALYSES ARE BASED UPON MINIMUM SKILLS, WORK STATION SHIFTING REQUIREMENTS, AND MAXIMUM FLIGHT RATE
- TOUCH LABOR INCREMENTS BASED UPON MINIMUM SKILL LEVELS AND AVERAGE UNIT VALUES DEVELOPED FROM AN 84% LEARNING CURVE
- ZERO BASE COST INCREMENTS WILL NOT EQUATE TO THE POP 91-1 SUBMIT DUE TO COSTS BEING BASED UPON STEADY-STATE CONDITIONS WHICH EXCLUDE BUILDUPS TO SUPPORT RAMP RATE INCREASES, COST REDUCTION INITIATIVES, AND CONSIDERATIONS FOR CURRENT INVENTORIES

27-Jun-91

ZERO BASE OPERATIONS COST STUDY
MSFC – EXTERNAL TANK
SHUTTLE OPERATIONS COSTS BY ELEMENT -- FY 94 IN RY $

PROJECT	ELEMENT	FLIGHT RATE ($)									
		1	2	3	4	5	6	7	8	9	10
ET	BASIC PRODUCTION	249.4	249.4	249.4	249.4	265.4	282.4	300.7	320.2	336.6	352.6
ET	FLIGHT SUPPORT	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4
ET	LOGISTICS	2.3	2.3	2.3	2.3	2.5	2.6	2.7	2.8	2.9	3.0
ET	LAUNCH SUPPORT SERVICES	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
ET	TECHNICAL DIRECTIVES	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
ET	SLIDELL COMPUTER COMPLEX	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2
ET	TE&A	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
ET	FACILITIES										
ET	- FACILITIES SELF-SUSTAINING	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7
ET	- PLANT OPERATIONS	31.7	31.7	31.7	31.7	31.7	31.7	31.7	31.7	31.7	31.7
ET	- MAF COMMUNICATIONS	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
	TOTAL	389.3	389.3	389.3	389.3	405.5	422.6	441.0	460.6	477.1	493.2

EXTE. .AL TANK
ZERO BASE OPERATIONS COST STUDY
BASIC PRODUCTION
FY94

	4/YEAR	8/YEAR	10/YEAR
MARTIN MARIETTA LABOR			
TOUCH RELATED (All VARIABLE)	$ 45.8M (496EP)	67.6 (746)	80.2 (888)
EQUIV. UNIT RELATED	$ 59.2M (641EP)	72.3 (807)	76.1 (856)
TIME/TASK (All Fixed)	$ 64.3M (697EP)	64.3 (697)	64.3 (697)
MATERIAL & SUBCONTRACTS			
VARIABLE	$ 40.9M	73.3	88.1
SEMI-FIXED	$ 11.5M	13.4	13.8
FIXED	$ 20.5M	20.5	20.5
OTHER COSTS	$ 7.2M	8.8	9.6
BASIC PRODUCTION	$ 249.4M	$320.2M	$352.6M

EXTE .AL TANK
ZERO BASE OPERATIONS COST STUDY
MANPOWER REQUIREMENTS
(EQUIVALENT)

	BASIC PRODUCTION			FIXED				
	TOUCH RELATED	EQ. UNIT RELATED	TIME/TASK	TECHNICAL DIRECTIVES	FLIGHT SUPPORT	LAUNCH SUPPORT SERVICES	FACILITIES SELF SUSTAINING	TOTAL
ENGINEERING								
@4	44	23	107	15	116	59	---	364
@8	51	36	107	15	116	59	---	384
@10	55	41	107	15	116	59	---	393
TOOLING								
@4	33	78	---	---	---	---	---	111
@8	37	91	---	---	---	---	---	128
@10	39	95	---	---	---	---	---	134
TOUCH								
@4	230	---	---	---	---	---	---	230
@8	404	---	---	---	---	---	---	404
@10	503	---	---	---	---	---	---	503
MGF. SPT.								
@4	106	239	99	29	3	---	4	480
@8	132	317	99	29	3	---	4	584
@10	143	347	99	29	3	---	4	625

EXTE. .AL TANK
ZERO BASE OPERATIONS COST STUDY
MMC LABOR TASKS

BASIC PRODUCTION - SUPPORT DEPARTMENTS

DEPARTMENT	ESTIMATING BASIS		
	TOUCH RELATED	EQUIVALENT UNITS RELATED	TIME AND TASK RELATED
ENGINEERING	Conceptual Design Dev. Prepare/Maintain System Drawings, Support PDR'S & CDR'S, Contractual Documentation, Compliance with I/F definition	Liason support to Production actions, Support MRB in resolving anomalies, Maintain FMEA/CIL, Maintain acceptance test requirements	Engineering Administration, Change processing, Special projects, production improvements, Scheduling and estimating
TOOLING	Design/Fab/Mod Replacement Tools, Tool Maintenance & Repair	Administration/Planning/Scheduling of Tooling Replacement and Tooling Maintenance & Repair, Fabrication dies, jigs, fixtures, and other specialized tools	

EXTE. AL TANK
ZERO BASE OPERATIONS COST STUDY
MMC LABOR TASKS

BASIC PRODUCTION - SUPPORT DEPARTMENTS

DEPARTMENT	ESTIMATING BASIS		
	TOUCH RELATED	EQUIVALENT UNITS RELATED	TIME AND TASK RELATED
MANUFACTURING SUPPORT	Supervise and train "Build" employees in Structures, TPS and Final Assy, Supervise and train Production Engineers	Industrial/Production Engineering, Production Control, Work Order Setup, Transportation and Handling, MAR's support, floor support to resolve problems	Estimating Change Control, Industrial Mgmt., Methods and Standards, Production Improvements, Master Plans and Scheduling
INSPECTION	Recurring Inspection of ET Hardware and Tooling Maintenance	Recurring inspection of Tool Maintenance	
QUALITY ASSURANCE SUPPORT	Inspection Supervision, Manufacturing Handling Plan compliance on Critical Hardware moves	Production Floor Quality Compliance, Vendor Surveillance, Process Control Development, Receiving & Shipping, Non-destructive testing and evaluation	Quality Administration, Procedures Development, Records Retention, ADP Development and Support, Production Improvements, Maintain dept. and company procedures

EXTL .AL TANK
ZERO BASE OPERATIONS COST STUDY
MANPOWER REQUIREMENTS
(EQUIVALENT)

	BASIC PRODUCTION			FIXED				
	TOUCH RELATED	EQ. UNIT RELATED	TIME/TASK	TECHNICAL DIRECTIVES	FLIGHT SUPPORT	LAUNCH SUPPORT SERVICES	FACILITIES SELF SUSTAINING	TOTAL
INSPECTION								
@4	60	5	---	---	---	---	---	65
@8	88	6	---	---	---	---	---	94
@10	109	6	---	---	---	---	---	115
QUALITY SUPPORT								
@4	23	149	41	13	19	---	6	251
@8	34	176	41	13	19	---	6	289
@10	39	186	41	13	19	---	6	304
PERF. ENHANCEMENT								
@4	---	---	18	2	---	---	---	20
@8	---	---	18	2	---	---	---	20
@10	---	---	18	2	---	---	---	20
MATERIAL								
@4	---	4	31	---	---	---	1	36
@8	---	8	31	---	---	---	1	40
@10	---	8	31	---	---	---	1	40

EXTE. AL TANK
ZERO BASE OPERATIONS COST STUDY
MANPOWER REQUIREMENTS
(EQUIVALENT)

	BASIC PRODUCTION			FIXED				
	TOUCH RELATED	EQ. UNIT RELATED	TIME/TASK	TECHNICAL DIRECTIVES	FLIGHT SUPPORT	LAUNCH SUPPORT SERVICES	FACILITIES SELF SUSTAINING	TOTAL
CONTRACTS								
@4	---	---	20	---	17	---	2	39
@8	---	---	20	---	17	---	2	39
@10	---	---	20	---	17	---	2	39
FINANCE								
@4	---	---	27	---	1	---	1	29
@8	---	---	27	---	1	---	1	29
@10	---	---	27	---	1	---	1	29
PLANNING								
@4	---	---	22	6	4	---	---	32
@8	---	---	22	6	4	---	---	32
@10	---	---	22	6	4	---	---	32
HUMAN RESOURCES								
@4	---	---	17	---	---	---	19	36
@8	---	1	17	---	---	---	19	37
@10	---	1	17	---	---	---	19	37

EXTE. .AL TANK
ZERO BASE OPERATIONS COST STUDY
MANPOWER REQUIREMENTS
(EQUIVALENT)

	BASIC PRODUCTION			FIXED				
	TOUCH RELATED	EQ. UNIT RELATED	TIME/TASK	TECHNICAL DIRECTIVES	FLIGHT SUPPORT	LAUNCH SUPPORT SERVICES	FACILITIES SELF SUSTAINING	TOTAL
MIS								
@4	---	---	138	---	17	---	1	156
@8	---	---	138	---	17	---	1	156
@10	---	---	138	---	17	---	1	156
SECURITY								
@4	---	---	---	---	---	---	105	105
@8	---	---	---	---	---	---	105	105
@10	---	---	---	---	---	---	105	105
FACILITIES								
@4	---	143	177	---	---	---	297	617
@8	---	172	177	---	---	---	297	646
@10	---	172	177	---	---	---	297	646
TOTAL								
@4	496	641	697	65	177	59	436	2571
@8	746	807	697	65	177	59	436	2987
@10	888	856	697	65	177	59	436	3178

EXTEI. .AL TANK
ZERO BASE OPERATIONS COST STUDY
MMC LABOR TASKS

BASIC PRODUCTION - SUPPORT DEPARTMENTS

	ESTIMATING BASIS		
DEPARTMENT	TOUCH RELATED	EQUIVALENT UNITS RELATED	TIME AND TASK RELATED
FACILITIES		Facilities Planning, Facilities Administration, Help Desk, Crib (storage), Plant Maintenance, Facilities Operations, Critical Systems Maintenance, Waste Disposal	Environmental Engineering, Equipment Engineering, R&A Craft, R&A Engineering, Maintenance Engineering, General Maintenance, IWTF Maintenance, Computer Support

EXTEI .L TANK
ZERO BASE COST STUDY
BASIC PRODUCTION
MATERIAL AND SUBCONTRACTS - VARIABLE COST

- EACH INCREMENT BASED UPON AN FY91 STEADY STATE ENVIRONMENT
- STEADY STATE ENVIRONMENT IMPLES NO GAPPING TO VENDORS
  - A CONTINUED 4/YR DELIVERY RATE COULD IMPACT EFFICIENCY AT VENDORS IF MSS IS A SIGNIFICANT PERCENT OF SUPPLIER BASE
- THE AVERAGE COST OF A FLIGHT HARDWARE SHIPSET IS $9.3M (BURDENED)

	FY94$ BURDENED TOTAL	AVG.
@ 4/YR	$40.9M	$10.2M
@ 8/YR	$73.3M	$9.2M
@10/YR	$88.1M	$8.8M

- FLIGHT HARDWARE SHIPSET COST IMPROVEMENTS
  - 73% OF THE FLIGHT-BILL-OF-MATERIALS WAS RECOMPETED BETWEEN 4TH AND 5TH BUYS RESULTING IN COST BENEFITS:

	FY91$
4TH BUY	$8.9M
5TH BUY	6.0

EXTE AL TANK
ZERO BASE OPERATIONS COST STUDY
BASIC PRODUCTION
MATERIAL AND SUBCONTRACTS - SEMI-FIXED

($ IN MILLIONS)*

	FY94		
	@4/YEAR	@8/YEAR	@10/YEAR
• PRODUCTION OPERATIONS			
• TOOLING MAINTENANCE	7.8	8.5	8.6
• TEST PANELS	.1	.3	.5
TOTAL	7.9	8.8	9.1
• FACILITIES			
• MAINTENANCE AND SUPPLIES	2.8	3.2	3.2
• WASTE DISPOSAL	.8	1.4	1.5
TOTAL	3.6	4.6	4.7
• TOTAL	11.5	13.4	13.8

* BURDENED

EXTE AL TANK
ZERO BASE COST STUDY
BASIC PRODUCTION
MATERIAL & SUBCONTRACTS - FIXED

- ENGINEERING
  - FAILURE ANALYSIS ACTIVITIES IN ENGINEERING LABS
  - SUPPORT QUALIFICATION OF NEW VENDORS
  - PRODUCTION TESTING - TPS SAMPLES
  - SUPPORT SPECIAL ENGINEERING PROJECTS
  - SUPPORT MFG. PROCESS IMPROVEMENTS
- PRODUCTION OPERATIONS
  - SUPPORT MFG. PROCESS IMPROVEMENTS
- PRODUCT ASSURANCE
  - SUBCONTRACT EFFORT FOR VALIDATING MANUFACTURING AND INSPECTION PROCESS
  - WITNESSING FABRICATION
  - CALIBRATION OF TESTING EQUIPMENT
  - QUALITY LAB SUPPLIES
- FACILITIES
  - MANUFACTURING AREA JANITORIAL AND R&A
  - ADPE MAINTENANCE AND SUPPLIES
  - AIR AND GROUNDWATER LAB ANALYSIS
- OTHER
  - SOFTWARE MAINTENANCE AND SUPPLIES
  - PERSONNEL TRAINING AND SUPPLIES

EXTE AL TANK
ZERO BASE OPERATIONS COST STUDY
BASIC PRODUCTION
MATERIAL & SUBCONTRACTS - FIXED

($ IN MILLIONS)*

	FY94		
	@4/YEAR	@8/YEAR	@10/YEAR
• ENGINEERING	2.7	2.7	2.7
• PRODUCTION	.7	.7	.7
• PRODUCT ASSURANCE	.8	.8	.8
• FACILITIES	16.0	16.0	16.0
• OTHER	.3	.3	.3
TOTAL	20.5	20.5	20.5

* BURDENED

EXTE...AL TANK
ZERO BASE OPERATIONS COST STUDY
FY94

	4/YEAR	8/YEAR	10/YEAR
FLIGHT SUPPORT - FIXED COSTS			
MCC LABOR	$ 18.4M (177EP)	18.4 (177)	18.4 (177)
LOGISTICS			
MATERIAL AND SUBCONTRACTS			
VARIABLE - BARGE MOVEMENT	$ .4M	.9	1.1
FIXED - BARGE OVERHAUL	$ 1.9M	1.9	1.9
TOTAL LOGISTICS	$ 2.3M	2.8	3.0
LAUNCH SUPPORT SERVICES			
MMC LABOR	$ 6.4M (59EP)	6.4 (59)	6.4 (59)
TECHNICAL DIRECTIVES			
MMC LABOR	$ 6.4M (65EP)	6.4 (65)	6.4 (65)
MATERIAL AND SUBCONTRACTORS	$ 3.2M	3.2	3.2
TOTAL TECHNICAL DIRECTIVES	$ 9.6M	9.6	9.6
SLIDELL COMPUTING COMPLEX OPERATIONS	$ 11.2M	11.2	11.2
TE&A (STE, I&PS, RI, SM&QA)	$ 6.5M	6.5	6.5

EXTE AL TANK
ZERO BASE OPERATIONS COST STUDY
FACILITIES RELATED TASKS
FY94

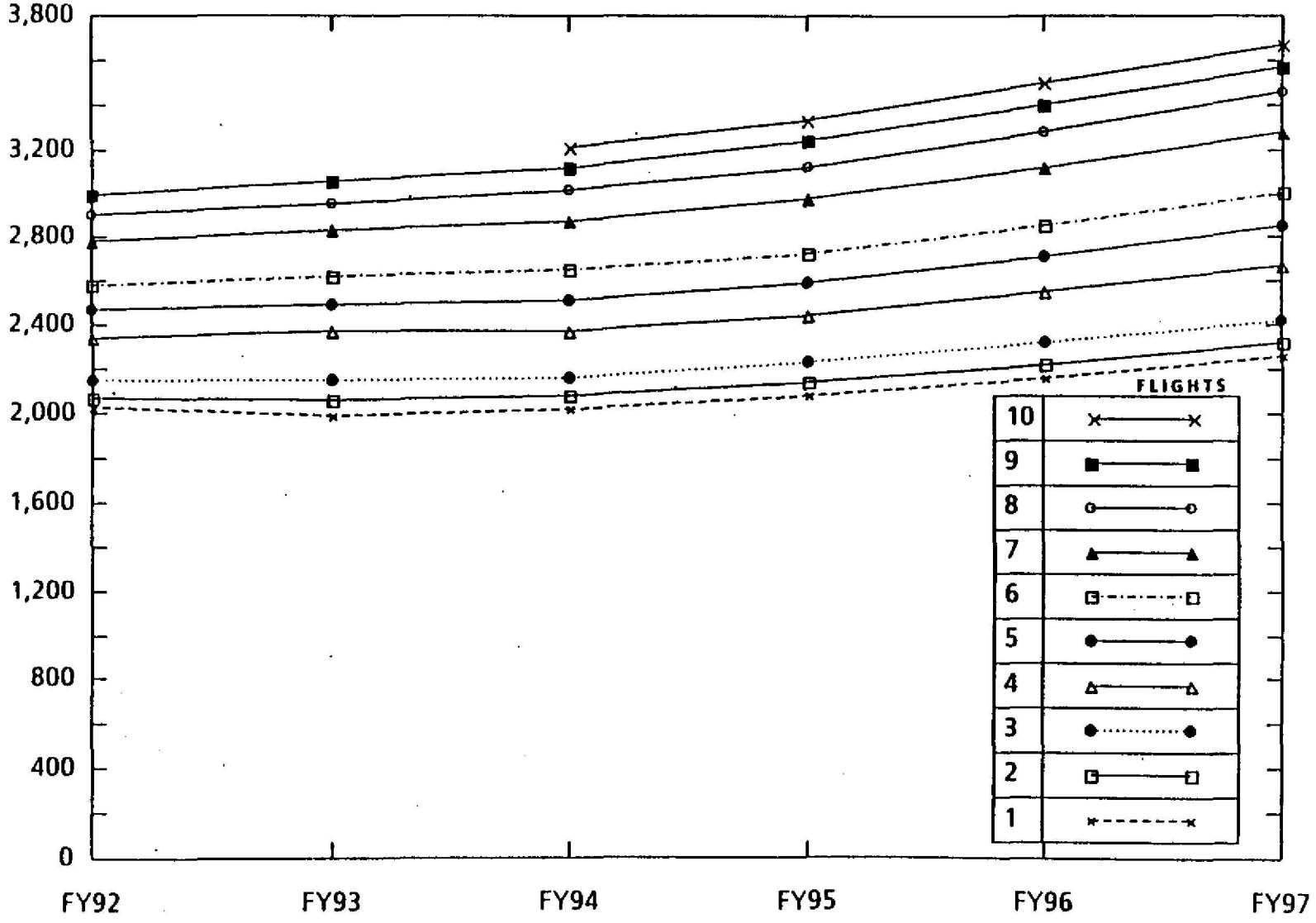
	4/YEAR	8/YEAR	10/YEAR
FACILITIES SELF-SUSTAINING			
MCC LABOR	$ 33.8M (436EP)	33.8 (436)	33.8 (436)
MATERIAL AND SUBCONTRACTS	$ 15.9M	15.9	15.9
TOTAL FACILITIES SELF-SUSTAINING	$ 49.7M	49.7	49.7
PLANT OPERATIONS	$ 31.7M	31.7	31.7
MAF COMMUNICATIONS	$ 4.1M	4.1	4.1
TOTAL FACILITIES RELATED	$ 85.5M	85.5	85.5

EXTERNAL TANK
ZERO BASE OPERATIONS COST STUDY
MANPOWER REQUIREMENTS
(EQUIVALENT)

	BASIC PRODUCTION			FIXED				
	TOUCH RELATED	EQ. UNIT RELATED	TIME/TASK	TECHNICAL DIRECTIVES	FLIGHT SUPPORT	LAUNCH SUPPORT SERVICES	FACILITIES SELF SUSTAINING	TOTAL
MIS								
@4	---	---	138	---	17	---	1	156
@8	---	---	138	---	17	---	1	156
@10	---	---	138	---	17	---	1	156
SECURITY								
@4	---	---	---	---	---	---	105	105
@8	---	---	---	---	---	---	105	105
@10	---	---	---	---	---	---	105	105
FACILITIES								
@4	---	143	177	---	---	---	297	617
@8	---	172	177	---	---	---	297	646
@10	---	172	177	---	---	---	297	646
TOTAL								
@4	496	641	697	65	177	59	436	2571
@8	746	807	697	65	177	59	436	2987
@10	888	856	697	65	177	59	436	3178

ZERO BASE OPERATIONS COST STUDY
TOTAL - SPACE SHUTTLE
TOTAL COST SUMMARY

(RY $ IN BILLIONS)



29-Jun-91

ZERO BASE OPERATIONS COST STUDY
ALL PROJECTS
PERCENT INCREASE OVER BASE -- FY 94 IN RY $

PROJECT	FLIGHT RATE ($)									
	1	2	3	4	5	6	7	8	9	10
LAUNCH OPERATIONS	100.0	108.0	115.1	150.4	160.7	169.4	199.7	211.8	216.2	220.3
EXTERNAL TANK	100.0	100.0	100.0	100.0	104.2	108.6	113.3	118.3	122.6	126.7
REDESIGNED SOLID ROCKET MOTOR	100.0	100.0	106.5	113.5	126.1	135.2	146.4	155.5	162.4	169.4
MISSION OPERATIONS	100.0	104.1	107.6	110.2	115.4	119.3	125.5	128.7	131.6	133.8
ORBITER	100.0	101.9	104.7	116.6	122.7	126.5	136.2	139.0	142.6	144.6
SHUTTLE LOGISTICS	100.0	105.4	112.1	119.6	125.4	134.8	148.3	159.2	170.2	175.1
SOLID ROCKET BOOSTER	100.0	102.7	111.4	119.5	129.2	135.8	148.1	155.5	165.8	174.1
SPACE SHUTTLE MAIN ENGINE	100.0	100.0	100.0	117.2	122.9	128.7	137.7	143.3	151.0	156.7
SPACE SHUTTLE PROGRAM OFFICE	100.0	101.2	103.6	107.7	112.8	118.9	123.9	128.7	133.5	137.8
OTHER										
- ENGINEERING	100.0	100.4	101.7	104.3	110.0	114.0	115.0	118.5	119.8	120.7
- FLIGHT CREW OPERATIONS	100.0	100.0	100.0	112.7	112.7	119.6	121.2	139.6	139.6	139.6
- PAYLOAD OPERATIONS	100.0	100.7	177.5	210.6	226.8	269.0	273.9	278.9	297.9	305.6
- PROPULSION SYSTEMS INTEGRATION	100.0	103.2	104.8	111.7	111.7	115.3	119.4	119.4	119.4	119.4
- SPACE AND LIFE SCIENCES	100.0	110.7	110.7	110.7	110.7	121.4	122.5	122.5	122.5	129.4

29-Jun-91

ZERO BASE OPERATIONS COST STUDY
ALL PROJECTS
SHUTTLE OPERATIONS COSTS -- FY 94 IN RY $

36%

PROJECT	FLIGHT RATE ($)									
	1	2	3	4	5	6	7	8	9	10
LAUNCH OPERATIONS	318.9	344.5	367.1	479.6	512.5	540.3	636.8	675.5	689.5	702.4
EXTERNAL TANK	389.3	389.3	389.3	389.3	405.5	422.6	441.0	460.6	477.1	493.2
REDESIGNED SOLID ROCKET MOTOR	281.2	281.2	299.5	319.1	354.7	380.1	411.7	437.3	456.8	476.3
MISSION OPERATIONS	249.1	259.2	268.0	274.4	287.5	297.2	312.5	320.6	327.9	333.4
ORBITER	145.2	148.0	152.0	169.3	178.2	183.7	197.7	201.9	207.0	210.0
LOGISTICS	119.5	126.0	133.9	142.9	149.9	161.1	177.2	190.2	203.4	209.3
SOLID ROCKET BOOSTER	111.0	114.0	123.7	132.6	143.4	150.7	164.4	172.6	184.0	193.2
SPACE SHUTTLE MAIN ENGINE	91.6	91.6	91.6	107.4	112.6	117.9	126.1	131.3	138.3	143.5
SPACE SHUTTLE PROGRAM OFFICE	140.3	142.0	145.4	151.1	158.2	166.8	173.9	180.6	187.3	193.4
OTHER										
– ENGINEERING	76.9	77.2	78.2	80.2	84.6	87.7	88.4	91.1	92.1	92.8
– FLIGHT CREW OPERATIONS	43.4	43.4	43.4	48.9	48.9	51.9	52.6	60.6	60.6	60.6
– PAYLOAD OPERATIONS	14.2	14.3	25.2	29.9	32.2	38.2	38.9	39.6	42.3	43.4
– PROPULSION SYSTEMS INTEGRATION	24.8	25.6	26.0	27.7	27.7	28.6	29.6	29.6	29.6	29.6
– SPACE AND LIFE SCIENCES	18.7	20.7	20.7	20.7	20.7	22.7	22.9	22.9	22.9	24.2

TOTAL FOR PROJECTS REVIEWED 2024.1 2077.0 2164.0 2373.1 2516.6 2649.5 2873.7 3014.4 3118.8 3205.3

75% of Test
= 512.5 + 287.5 + 149.9 = 949.9 × 0.75
= 712.4
+ Orb 178.7
+ SSME 112.6
= 1003.7

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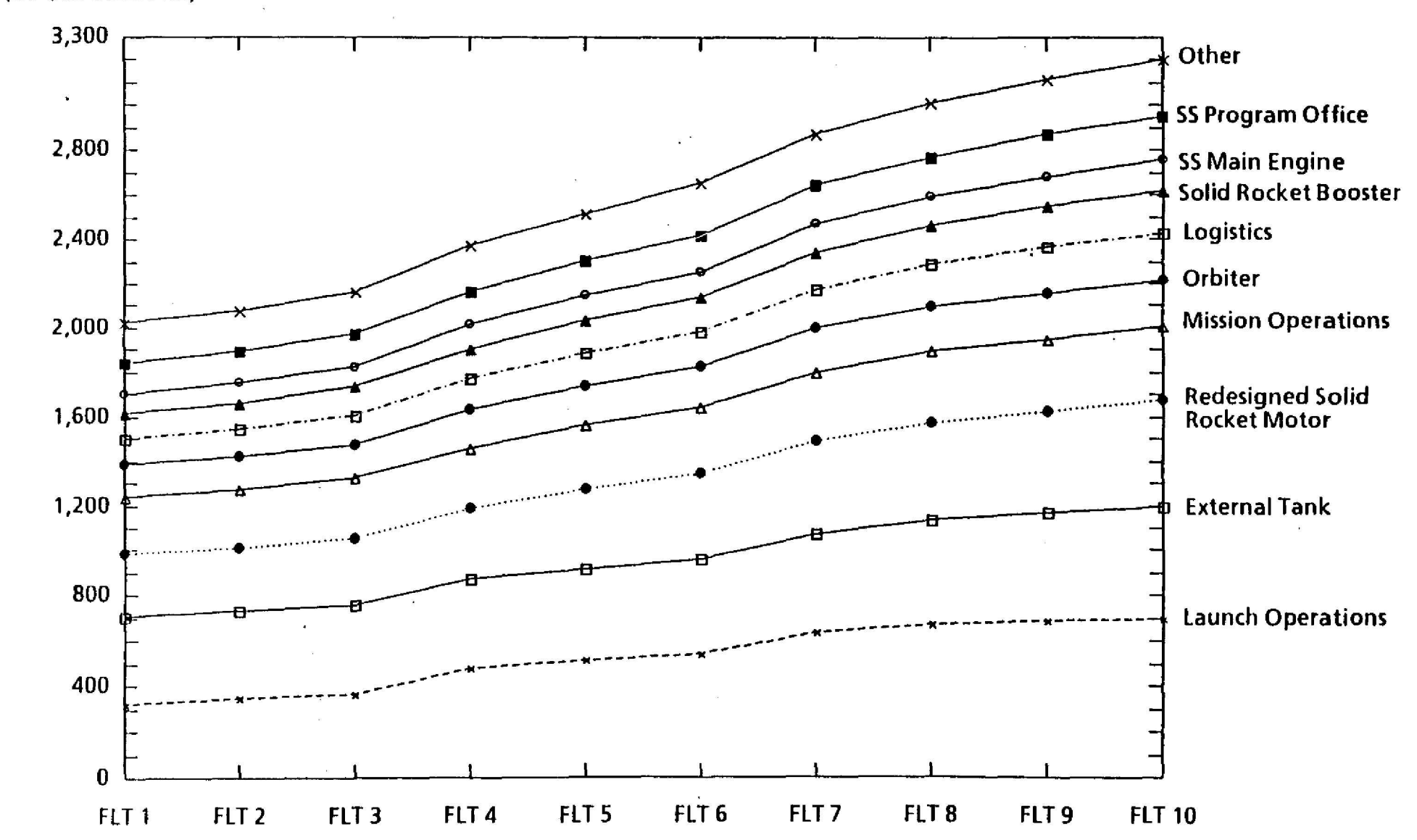
SPACE SHUTTLE PROGRAM
ZERO BASE OPERATIONS COST STUDY
SHUTTLE OPERATIONS COSTS -- FY94 IN RY $



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